

### **REMARKS**

By this amendment, claim 1 is amended, claims 3-7 are canceled and new claim 24 is added to place this application in condition for allowance. Currently, claims 1, 2, and 8-24 are before the Examiner for consideration on their merits.

In review, claim 1 has been revised to further define the invention, and include subject matter of original claims 6 and 7. New claim 24 defines a specific recycling of the molten salt whose concentration is increased by Ca generated in the electrolysis step.

In light of the revisions to claim 1, it is submitted that the rejection set forth in the Office Action is no longer valid and must be withdrawn. The rejection is addressed below under the headings of the INVENTION and ARGUMENTS.

### **INVENTION**

The features of the claimed invention consist in the marked behavior of Ca during a Ca reducing reaction within a molten  $\text{CaCl}_2$  for manufacture of Ti or a Ti alloy. These features are explained in detail in paragraphs [0016-0020] in Applicants' published patent application.

In the inventive method for producing Ti through reduction by Ca, a  $\text{TiCl}_4$  solution is supplied to the liquid surface of the molten Ca liquid in the reactor vessel, thereby enabling the  $\text{TiCl}_4$  to be reduced by Ca to generate the particulate metallic Ti. The generated metallic Ti successively moves downward.

At the same time that the metallic Ti is moving downward, the molten  $\text{CaCl}_2$  is generated as a by-product where the specific gravity of molten  $\text{CaCl}_2$  is larger than that of the molten Ca. Therefore, the molten  $\text{CaCl}_2$  as a by-product moves underneath the molten Ca, whereby the molten Ca can be continuously supplied to the reaction area and the reaction is continued.

The characteristic of the molten Ca is to be dissolved in the molten  $\text{CaCl}_2$  by-product, whereas Ca can be dissolved in the  $\text{CaCl}_2$  by about 1.5%. Since Ca can be

dissolved in the molten  $\text{CaCl}_2$ , this means that the reaction of generating Ti through reduction by Ca within the molten  $\text{CaCl}_2$  can proceed sustainably.

By utilizing the reduction reaction by Ca in the molten  $\text{CaCl}_2$ , the reaction area that is conventionally restricted in the vicinity of the liquid surface of reducing agent inside the reactor vessel can be dramatically enlarged and the heat dissipation also is enlarged to thereby facilitate the cooling, whereby the feed rate of  $\text{TiCl}_4$ , a raw material of Ti, can be greatly increased and productivity is markedly improved.

In a Mg reduction process which has been used in producing Ti in the prior art, Mg is hardly dissolved in  $\text{MgCl}_2$ , while Ca can be dissolved in a molten  $\text{CaCl}_2$  by-product, which is a big difference between the two. And, the dissolution phenomenon of Ca is used to be considered as the obstacle for commercialization simply because this makes the rigorous separation difficult in a reduction step and in an electrolysis step where the molten  $\text{CaCl}_2$  by-product is electrolyzed into Ca and  $\text{Cl}_2$ . Thus, the Ca reduction process has not been applied for commercial production of Ti. That is, the dissolution of Ca in  $\text{CaCl}_2$  becomes a big obstacle so that a Ca reduction process has not been applied for commercial production of Ti.

In contrast, the present invention, as now defined in independent claims 1, 8, 17, and 18, has the  $\text{CaCl}_2$  returning from a reactor vessel to an electrolysis step to form Ca, and again recirculating into the reactor vessel, while  $\text{TiCl}_4$  as a raw material of Ti is directly supplied into molten  $\text{CaCl}_2$  to cause the large scale reaction, i.e., a three dimensional reaction, with the Ca dissolved in the  $\text{CaCl}_2$

## ARGUMENTS

### Claim 1 Bienvenu and Winter

Bienvenu relates to a metal powder. The metal halide to be reduced is  $\text{TiCl}_4$  and the reducing metal is Ca as shown in Example 1. A quantity of  $\text{CaCl}_2$  is poured into a reactor and a fused bath is formed at a temperature of 830 °C.  $\text{TiCl}_4$  is fed and reduced by Ca. The lower half of the bath was withdrawn after reaction completion and titanium powder was formed, see col. 4, line 62 to col. 5, line 28.

Turning to claim 1, this claim requires an electrolysis step as well as a return of the Ca generated by the electrolysis step and the molten  $\text{CaCl}_2$ .

Since these steps are derived from claims 6 and 7 and it is admitted that Bienvenu does not teach these step, the question of obviousness is whether Winters makes up for the failing in Bienvenu in this regard.

Winter relates to an integrated two-step novel reduction process for producing titanium metal. This process comprises reacting highly pure  $\text{TiCl}_4$  in a primary reduction stage of the process with Na metal, as being a reduction reaction, and then reacting the reactants thus obtained in a secondary reduction stage with Mg-Ca. As shown in Winter, it is disclosed that the halide metal salt by-product generated in the reduction reaction is recovered in the electrolysis step, thereby recovering reducing metals such as Na, Ca, and Mg, along with  $\text{Cl}_2$ .

Winter is not intended to reduce the solution to Ti in a primary stage as is the case in Bienvenu. Instead, Winter employs a two step process to reduce  $\text{TiCl}_4$  to a molten titanium subchloride-sodium salt composition in the primary stage, followed by a secondary stage where the reduction for producing Ti is carried out. Therefore, the Winter two step process is completely different from the instant invention and Bienvenu, both or which are one step processes. Because Winter and Bienvenu are fundamentally different from each other, one of skill in the art would not look to Winter to modify Bienvenu even with the teachings of Winter in col. 1.

Further, the electrolysis of Winter is for the specific purpose of generating Na for the primary reduction stage and Ca-Mg for the secondary reduction stage. In claim 1, the electrolysis step returns both Ca and  $\text{CaCl}_2$  to the reduction step. Even if the Examiner were to say that it would be obvious to employ an electrolysis step in Bienvenu to produce the Ca being introduced at 6, the introduction of Ca and  $\text{CaCl}_2$  as defined in claim 1 is not taught in Winter. Therefore, the combination of Bienvenu and Winter does not teach all of the features of claim 1 and a *prima facie* case of obviousness is not established.

Also, the mere fact that Winter teaches that electrolysis can be used to recover magnesium for use in a reduction step does not necessarily mean that it would be

obvious to employ an electrolysis in the manner of claim 1. That is, the electrolysis step requires that the  $\text{CaCl}_2$  being electrolyzed is produced as a by-product in association with the generation of Ti particles and this particular step is not found in Winter. This is another reason why Bienvenu and Winter do not establish a *prima facie* case of obviousness against claim 1.

It is also argued that the Examiner has not addressed the claim limitation that the reaction of the metallic chloride with Ca is with Ca that is in the molten salt. This feature is explained above and there is no mention of this aspect of the invention in the rejection. More particularly, while alleging that this claim step is present, the Examiner does not specifically identify where this step is expressly or implicitly taught and the rejection is improper for this reason.

The one step process of claim 1 is also vastly superior to that of Bienvenu as explained in the INVENTION section of this response. The improvements are unexpected and these improvements are further substantiation that the invention as defined in claim 1 is patentable over the combination of Bienvenu and Winter.

Claims 8 and 18 Bienvenu and Winter.

Claims 8 and 18 includes the electrolysis step and a Ca source circulation step. Claim 8 is believed to be patentable for the same reasons as claim 1 when considering the electrolysis step. Also, it is submitted that the Examiner has not fully addressed the circulating step of claim 8 and this omission means that a *prima facie* case of obviousness has not been established.

Applicants submit that the inherency position with respect to the limitation regarding Ca concentration is not supported in the rejection. The Examiner has only concluded inherency but has not provided any factual support for drawing this conclusion. Bienvenu says nothing about the reduction of  $\text{TiCl}_4$  using Ca in the molten salt. In order to assert inherency, the Examiner must have a basis to do so and express it in the rejection. No such basis is put forth so that the rejection of claim 18 with respect to this limitation is improper.

It is also submitted that the rejection is flawed with respect to the reduction step for the reasons set forth above for claim 1.

Claim 17 and Bienvenu

In the rejection, the Examiner alleges that Bienvenu anticipates claim 17. Applicants traverse this rejection for two reasons. First, claim 17 defines a reduction step similar to that of claims 1 and 8 and the rejection does not squarely address the particulars of this step, particularly the reaction of Ca in the salt with  $\text{TiCl}_4$ .

Secondly, Applicants submit that the inherency position is not supported in the rejection for the same reasons as set out above for claim 18.

New Claim 24

New claim 24 defines a recycling step of the molten salt. It is submitted that neither Bienvenu nor Winter teach the step of claim 24 and this claim is separately patentable over the applied prior art.

SUMMARY

To recap, each of the independent claims has been demonstrated to be patentable over either Bienvenu or the combination of Bienvenu and Winter. Therefore, these claims along with their respective dependent claims are now in condition for allowance.

Accordingly, the Examiner is requested to examine this application and pass all pending claims onto issuance.

If the Examiner believes that an interview would be helpful in expediting the allowance of this application, the Examiner is requested to telephone the undersigned at 202-835-1753.

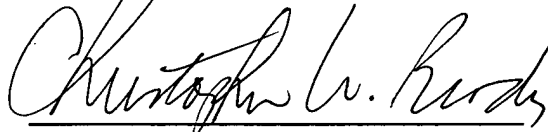
The above constitutes a complete response to all issues raised in the Office Action dated April 29, 2008.

Again, reconsideration and allowance of this application is respectfully requested.

Application No.: 10/575,225

Applicants respectfully submit that there is no fee required for this submission, however, please charge any fee deficiency or credit any overpayment to Deposit Account No. 50-1088.

Respectfully submitted,  
CLARK & BRODY

A handwritten signature in cursive script, appearing to read "Christopher W. Brody", written over a horizontal line.

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